



Citation
for
Meritorious Achievement

Presented to
**Defense Contract Management Command,
Defense Logistics Agency,
Fort Belvoir, Virginia**

In Recognition of
Outstanding Accomplishments during 1997
in

Pollution Prevention

under the
**Department of Defense
Environmental Security Program**

April 27, 1998

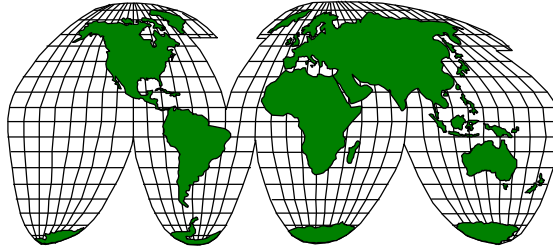
Date

A handwritten signature in black ink, reading "William L. Gort", is positioned above the title "SECRETARY OF DEFENSE".

SECRETARY OF DEFENSE

Secretary of Defense Environmental Security Award

Pollution Prevention — Weapon Systems Acquisition Team

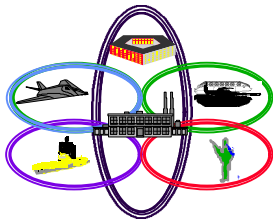


ACQUISITION POLLUTION PREVENTION INITIATIVE (AP2I)

Sponsored by

**The Joint Group on Acquisition Pollution Prevention (JG-APP)
And Boeing Company**

Presents



Aircraft Nonchromate Primer



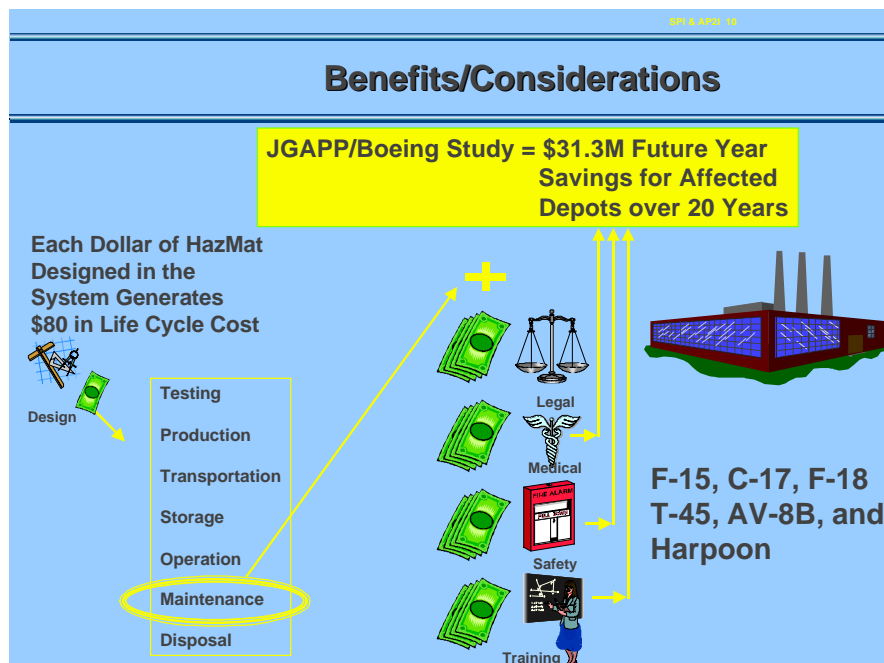
INTRODUCTION:

The aircraft nonchromate primer team is a JG-APP sponsored effort with Boeing Company. It involves testing, validation and implementation of a primer paint that does not contain chromium, a highly toxic carcinogenic material that has been targeted by the Environmental Protection Agency and included on its list of top 17 hazardous materials. When working with paints that contain chromium, workers must use protective equipment to minimize their exposure and emission control equipment must be employed to prevent discharge of chromium into the environment. Aircraft must periodically be stripped and repainted, which creates a hazardous material health and disposal problem for both manufacturer and Department of Defense (DoD) depot-logistic center communities.

Replacement of aircraft chromate primers will directly benefit military and commercial aircraft painting and repainting processes. The nonchromate primer alternatives currently being field tested on Navy F/A-18, T-45s, Harpoon missile canisters and Air Force F-15 aircraft could potentially eliminate most chromium from aircraft exterior mold line surfaces. It could also reduce the need for protective equipment and training, increase productivity and lower both acquisition and sustainment environmental compliance costs.

The team identified twenty-eight alternative primer materials to replace chrome primer coatings. Based on the results of screen tests, nine nonchromate primers were selected as potential alternatives to undergo full laboratory testing. The team developed a joint test protocol (JTP) that contains the critical technical and performance requirements for qualifying these potential alternatives, including the laboratory and operational (field) testing to be performed. Based on the results of laboratory tests, two nonchromate primers were selected to undergo operational field-testing. Operational tests are underway with a scheduled completion date of December 1999. It is too early to declare complete success but preliminary results have proved very positive.

Once field-testing is complete, the Defense Contract Management Command (DCMC) will process a contractual block change modification to replace the chromate primers currently specified in Government contracts. At a minimum, this alternative process will reduce or eliminate chromium from primer paint coatings on at least six military weapon systems. The JGAPP support contractor, the National Defense Center for Environmental Excellence (NDCEE) was tasked to do an in-depth cost-benefit analysis. With Boeing's assistance, NDCEE was able to determine that cost avoidance benefits to the sustainment community for just these initial six programs will be in excess of \$31.3M over a 20 year period.



BACKGROUND:

On September 15, 1994, the Joint Logistics Commanders (JLC) chartered JG-APP. This DoD partnership was established to overcome duplication of efforts in changing military specifications/standards, budget constraints for pollution prevention, and to establish common test protocol acceptance of alternatives. Flag rank military officers from the Air Force, Army, Marine Corps, Navy, and DCMC lead the JG-APP. The Joint Pollution Prevention Advisory Board (JPPAB) is comprised of working-level managers from the three services, Marine Corps, and DCMC. Together with NDCEE, they provide the continuity for initiating and managing acquisition pollution prevention initiatives such as the aircraft nonchromate primer project.

Boeing Company, like other defense contractors involved in changing manufacturing processes, found it difficult to achieve consensus for an environmentally beneficial alternative across service lines. Each program would want to test a recommended alternative to determine if it was suitable. In May 1995, acquisition managers, Boeing (at that time McDonnell Douglas Aerospace in St. Louis), and JPPAB members met to prioritize their pollution prevention opportunities and to select their first joint group project, elimination of chromate primers.

On 15 May 97, the Principal Deputy Under Secretary of Defense for Acquisition and Technology recognized the need to integrate pollution prevention solutions into the weapon system acquisition process. As a result, he chartered AP2I, which links the DoD Single Process Initiative (SPI) with JG-APP. DCMC is responsible for leading both AP2I and SPI. JG-APP provides for identification, testing, acceptance of alternatives, and leveraging them into sustaining logistics processes with the assistance of the JLC Joint Depot Environmental Panel (JDEP).

SPI was developed to improve efficiency by enabling the timely consolidation or elimination of multiple management and/or multiple process requirements on existing contracts from defense contractor manufacturing operations. To initiate the SPI process, a defense contractor submits a concept paper to the assigned DCMC Administrative Contracting Officer describing the requested process modification. If the requested modification is technically acceptable, a series of events take place to approve a “block change” contract modification that simultaneously modifies all affected contracts at the defense contractor facility.

AP2I formally links SPI with JG-APP. DCMC has a key role to ensure the two initiatives flow together to achieve the maximum result. As such, DCMC receives pollution prevention opportunities via concept papers. If the concept paper proposes a modification to current materials/processes that have been qualified as technically acceptable to the government, DCMC will facilitate the immediate implementation of a “block change” under SPI. However, if the proposed modification requires qualification, JG-APP will coordinate the technical and business resources required to qualify an alternative. These resources include identifying and testing the technical and operational performance requirements and performing economic analysis of the potential alternatives.

Once an alternative is qualified as technically acceptable to the government, a “block change” is utilized to implement the alternative across all affected weapon systems. The AP2I process, which incorporates the validated JG-APP methodology, has a target timeline of 420 days from proposal/identification to implementation. The timeline varies depending on the complexity of manufacturing operations. In the case of the aircraft nonchromate primer, the team has been working since May 1995 to qualify products. A concept paper has been prepared and accepted by DCMC with implementation pending successful completion of field-testing required to validate alternative primers.

Weapon System Acquisition Team Points of Contact: The Aircraft Nonchromate Primer Team is a large team involving many people from many different organizations. It includes DoD programs, DCMC and the Boeing St. Louis MO and Long Beach CA sites. There are over 70 individuals involved in the project representing 32 different DoD and NASA organizations and groups including six Navy and Air Force program offices. The current POCs are as follows:

Boeing Company:

- Richard Pinckert, St. Louis, 314-234-0623
- Larry Triplett, St. Louis, 314-232-2882

DCMC:

- Ray Massey, Boeing, St. Louis, 314-233-9199

JPPAB:

- Robert Hill, (Chairman), AFMC, 937-656-3678
- David Asiello, (Technical) JDEP, CNO, 703-602-5334
- Sydney Pope, (Business) AP2I, DCMC, 703-767-3380

National Defense Center on Environmental Excellence:

- Brenda Daniel, CTC, 814-269-6494
- Michael Docherty, CTC, 814-269-6462

Major Weapon System Programs:

- James Whitfield, AV-8B, NADEP Cherry Point, 919-464-7342
- Captain Martin Alexis (USAF), C-17 Program, WPAFB, 937-656-9311
- Stephen Kid, F-15 Program, WR-ALC, 912-926-5476
- Tim Woods, F/A-18 Program, Naval Aviation Depot, 619-545-9757
- Ed Werkmeister, Harpoon/SLAM, NAVAIR, 301-757-6076
- Jean Hawkins, T-45 Program, T-45TS, 904-633-4082

PROGRAM SUMMARY:

At Boeing in St. Louis, MO, one of the initial seven JG-APP sites, operational testing has begun. The objective of the Aircraft Nonchromate Primer Team was to find an alternative(s) to chromate-containing primer coatings for aircraft exterior mold line skins. Finding an alternative(s) to this hazardous material at this site will benefit various programs within the Air Force (C-17 and F-15 aircraft) and the Navy (AV-8B, F/A-18, and T-45 TS aircraft and Harpoon/SLAM). Based on the results of screening tests, a Type I, Standard Pigments, nonchromated primer and a Type II, Low Infrared Reflective Pigments (Low IR), nonchromated primer were selected as possible alternatives. The difference between the Type I and Type II is amount of infrared reflectance (IR) capability with Type II having a lower IR.

ACCOMPLISHMENTS:

Operational testing of the F/A-18 and F-15 aircraft involved priming the test portion of each aircraft with the selected nonchromated primer and the remaining portion with conventional chromated primer to compare the alternative and conventional primer under the same operating conditions. Two F-15 aircraft and eight F/A-18 aircraft are being used in operational testing. All of the F/A-18s were primed with the Type II Low IR primer. The F-15 aircraft used for operational testing have one wing primed with the Type I primer.

As part of the operational testing, the Type I primer has been applied to a Harpoon canister during scheduled maintenance and to selected panels on three T-45 aircraft. It is also being used for touch-up applications on mold line surfaces of a T-45 TS training aircraft. The Type II primer will be used for operational tests on AV-8B aircraft after initial results from the other operational tests is analyzed. The test aircraft and Harpoon canisters are being inspected periodically during field evaluations.

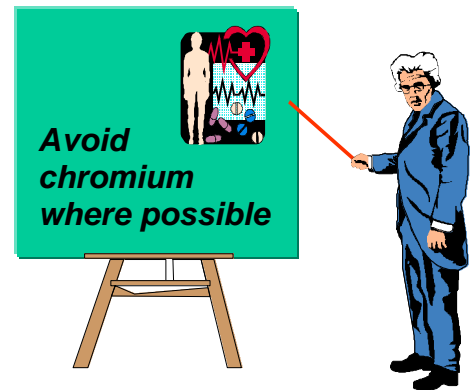
Field evaluations will be completed in December 1999. They should confirm laboratory tests that already indicate that the alternative(s) meet performance requirements necessary to progress to operational testing. Implementation on the Air Force's C-17 and F-15 aircraft and the Navy's AV-8B, F/A-18, and T-45 TS aircraft and Harpoon/SLAM weapon system will follow successful completion of field-testing.

Implementation of aircraft nonchromate primers is anticipated to eliminate approximately 650 lbs. of Hexavalent chromium a year during manufacturing alone. The Air Force and Navy will avoid hazardous waste disposal costs and decrease personnel health concerns associated with the handling of chromate primers during depot operations for these weapon systems.

Incorporating Environmental Analysis Into the Acquisition Decision Making Process

On March 30, 1995, representatives from DoD program office and sustainment communities meet with Boeing St. Louis and JG-APP spokespersons to discuss hazardous materials of common concern and to identify candidate materials for joint evaluation and possible reduction or elimination. They agreed upon a short list of hazardous materials for possible investigation, which included chromium, cadmium, methylene chloride, and methyl ethyl ketone. The participants decided to focus on nonchromate primers for laboratory testing due to the significant health risk they present and the high potential payback to both Boeing and the sustainment community if eliminated from painting and repainting processes.

Chromium is an essential metal for human health, but, at elevated levels, it elicits toxic effects including cancer. Inhalation exposure to chromium causes lung and nasal cancer. The International Agency for Research on Cancer, the National Toxicology Program, and the American Conference of Governmental Industrial Hygienists classify Hexavalent chromium as a human carcinogen. Non-cancer respiratory effects are also a major concern for chromium-exposed individuals. Chromium is corrosive and irritating to skin, eyes, and mucous membranes. Chromium inhalation also produces nasal ulceration known as “chrome holes”.



Dermal exposure to chromium produces an allergic hypersensitivity reaction in some individuals, similar to that observed with nickel. Oral exposure, while less common in the workplace, can result from hand-to-mouth transfer. Ingestion of chromium can result in renal tubular necrosis. In laboratory tests with human and animal tissues, chromium is a genotoxicant capable of producing single- and double-strand DNA damage, DNA-protein cross-links, and DNA-DNA cross-links. Intravenously administered chromium (VI) oxide is a teratogen and reproductive toxicant in laboratory rodents.

Material Substitution

Boeing identified chromium, as contained in primer paint systems, as the target hazardous material to be eliminated or reduced. The current process is primer application by conventional wet-spray coatings applied to aircraft exterior mold line skins. The main substrates are aluminum alloys such as 2024 and 7075 that have been anodized or chromate conversion coated, but other substrates such as steel and titanium are also present on aircraft exterior surfaces and are coated by these primers.

As documented in the Potential Alternatives Report (PAR), which is being developed, twenty-eight alternatives having potential to replace chrome primer coatings were identified through literature searches and direct vendor queries. Based on the results

of screening tests, nine nonchromate primers were selected as potential alternatives to undergo full laboratory testing in accordance with the Joint Test Protocol (JTP).

The JTP contains the critical technical and performance requirements for qualifying these potential alternatives, including the laboratory and operational (field) testing to be performed. Based on the results of laboratory testing, two nonchromate primers were selected to undergo operational testing. The operational testing has been initiated with a scheduled completion date of December 1999.

The two nonchromate primers selected by the team for use in operational testing are Crown Metro Aerospace 10PW22-2/ECW-119 (Type I) and Spraylat EWAE118 A/B (Type II). The Crown Metro product has been applied to the F-15s, Harpoon canister and used for touch-up on T-45 TS. The Spraylat product will be applied to the AV-8B and has been applied the eight F/A-18s that were painted as part of the operational testing. The Spraylat product was chosen for these aircraft because the Navy currently requires Type II primers on tactical aircraft.

Two Joint Test Reports (JTRs) are being prepared. JTR-1 is being developed to document the results of laboratory testing; JTR-2 will document the results of operational testing. A qualified alternative will reduce chromium from the Boeing sites in St. Louis, MO and Long Beach CA on weapon systems participating in this project. It will allow for a block change under the Single Process Initiative (SPI) to replace the chromated primers specified by MIL-P-23377 Class C and MIL-P-85582 Class C1 and Class C2, thereby affecting at least six Department of Defense programs.

Improved Material Management

Acquisition managers had their technical specification and engineering staffs work with JPPAB and Boeing to evaluate operational performance requirements for chromate primers. The team developed a list of qualified alternatives. All agreed that duplication of effort would be minimized by jointly addressing pollution prevention at the material specification level together. Focusing on the original equipment manufacturer's process as the starting point for pollution prevention provided an opportunity to:

- 1) identify shared processes and common specifications,
- 2) change current designs and identify less hazardous materials,
- 3) influence future performance and design considerations, and
- 4) develop a strategy for validating acceptable alternatives for both acquisition and sustaining logistics communities in a coordinated manner.

The team integrated pollution prevention activities into a commonly shared point in the material management process. This integration activity involves identifying opportunities, prioritizing processes that require hazardous materials, identifying shared processes and affected program/weapon system managers, establishing common test protocols for alternative qualifications, and joint coordination of alternatives acceptance and implementation.

The end result will be a reduction and potentially complete elimination of chromium primers in contractor design, manufacturing, and remanufacturing with a bridge to the sustainment community as well. Chromate primer will be replaced on outer moldline skins on AV-8B, C-17, F-15, F/A-18, Harpoon/SLAM, T-45 TS weapon systems.

Fleet experience on moldline skins is an essential first step to developing confidence for a complete switch to nonchromate primers. Results from operational tests will be used to determine if primer on internal structures can also be changed over to nonchromate. Primer on internal surfaces is a stand alone coating which must provide protection for the life of the airframe. For just outer moldline skins, Boeing estimates that implementation of the team's aircraft nonchromate primer will eliminate approximately 650 lbs. of Hexavalent chrome a year from manufacturing processes.

Research, Development, and Technology Demonstration/Validation

On-going activities include operational testing and field inspection. The first Aircraft Nonchromate Primer Team inspection of two F-15 aircraft occurred in late January 1998. No major concerns were reported, although some adhesion failure of both chromate and nonchromate primers applied to titanium surfaces was noted.

Eight F/A-18s have been partially primed with nonchromated primer and returned to their operational units. The first inspection of F/A-18s occurred in February. There were no significant differences discernible between the performance of chromated and nonchromated surfaces.

Three removable panels on each of three T-45 TS aircraft were primed with Crown Metro Aerospace 10PW22-2/ECW-119 on the inside and outside surfaces. At the same time, chromate primer was applied to three other panels on each of the three T-45 TS aircraft. This test adds a new element to the field evaluation by testing non-topcoated primer on the interior surfaces of the panels. These three aircraft have returned to operational status, and no coating deficiencies have been reported to date.

One Harpoon canister has been primed with nonchromate primer and another with chromated primer. They are both awaiting ship assignment and the team will be tracking their progress.


Finding a way to pay for all the testing, validation effort and documentation necessary to complete the project proved to be just as difficult for the Nonchromate Primer Team as identifying potential alternatives and reaching consensus on test protocols. Fortunately all the major players saw the benefit to be derived by pooling resources. In particular, the C-17 program was able to move the funding issue beyond discussion by providing the funds necessary to cover initial laboratory tests. The operational tests were easier to address because each program could decide on its own how much testing they would pay for on their weapon system versus how much they would rely upon the results demonstrated on other systems. JG-APP and Boeing also

help to reduce the individual program costs by covering documentation, materials and other costs. What greatly aided project administration was the use of a single NDCEE contract with Boeing for performance of all test and validation related work.

SP1 & APP 2

How to Pay for This?

- **Project Cost \$1.25M**
- **C-17 Contracted Boeing for Lab Work, \$500K**
- **Other Programs Cover Ops Tests**
- **JG-APP Covered Shortfall & Documents**
- **Boeing Contributed Test Coupons & Sample Prep**
- **Tests Performed by Boeing Under NDCEE Contract**



Process Modification or Improvement

Paint primers account for the single largest source of chromium used. Even so Boeing, albeit at great expense, has been able to remain in compliance with environmental and occupational safety and health regulations. Workers are required to wear protective equipment, and suitable emission controls must be applied. However, the Occupational Safety and Health Administration (OSHA), which is responsible for promulgating permissible worker exposure limits, is in the process of establishing stricter exposure limits from the current levels of 100 micrograms per cubic meter of air to an anticipated 0.5 micrograms per cubic meter. This is why elimination of chromium from paint primers has such a high potential payback to both Boeing and the Sustainment Community.

The anticipated reduction of the permissible exposure limit (PEL), by OSHA, will result in increased cost at the contractor sites and the sustainment facilities. A 0.5 PEL would likely require additional worker protection in areas beyond the painting and depainting booths. Paint booths and areas where chromated primer is removed may need to be classified as hazardous areas even when no painting or depainting is occurring due to residual contamination. Production would be impacted by inefficiencies associated with the donning of protective suits to enter the areas and decontamination requirements

to exit. Implementation of nonchromated primer on exterior surfaces is expected to prevent having to classify final paint booths and depaint areas as hazardous.

Education and Outreach

The Aircraft Nonchromate Primer Team has briefed its efforts to other government programs and industry. In particular, the F-16 Program Office has decided to perform field evaluations with two of the down-selected JG-APP primers on Lockheed Martin F-16 wing panels based, in-part, on laboratory results obtained from the team. In addition, laboratory test results have been briefed to Bell Textron, the SAE-G8 Coatings Committee, the Canadian and Australian Air Forces plus other DoD and industry forums.



In addition, the results of laboratory testing are being published on the JG-APP World Wide Web site, but products that were not chosen for operational testing will not be identified by name in order to insure their continued cooperation in testing and validating new alternatives as they are developed.

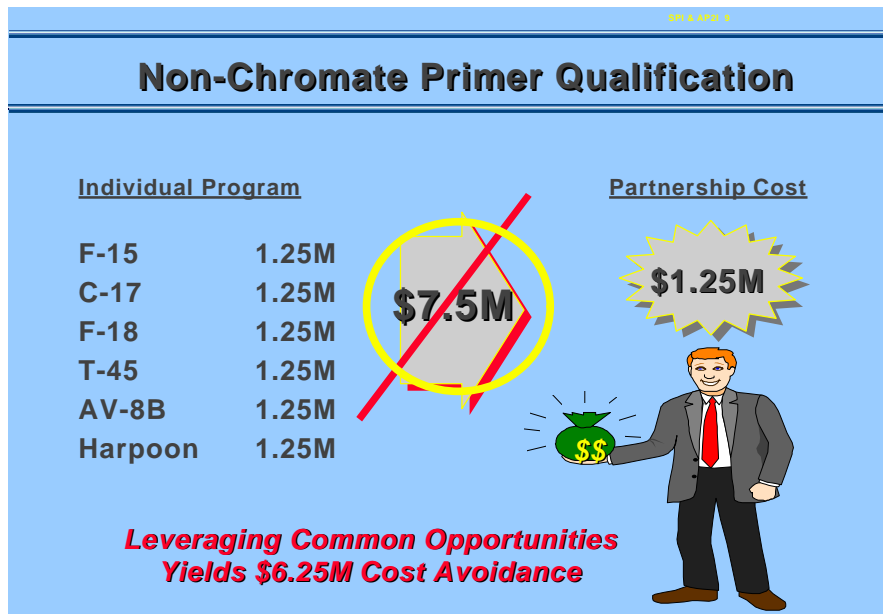
Organizations and groups that routinely receive updates on project status and who have also provided invaluable contributions to this AP2I success are as follows:

Aeronautical Systems Center, Environmental Management Office
Air Education and Training Command
Air Force Corrosion Program Office
Air Force Material Command, Headquarters
Apache Program Office
Army Material Command, Headquarters
AV-8B Program Office
Boeing Company
C-17 Program Office
Chief of Naval Operations, Environmental Programs Division
Defense Contract Audit Agency – St. Louis, Missouri
Defense Contract Management Command – St. Louis, Missouri
Defense Contract Management Command, Headquarters
F/A-18 Program Office
F-15 Program Office
Harpoon/SLAM Program Office
Industrial Operations Command, Headquarters
Joint Depot Environmental Panel
Marine Corps Air Station Beaufort
National Aeronautics and Space Administration

National Defense Center on Environmental Excellence
 Naval Air Station Cecil Field
 Naval Air Station Kingsville
 Naval Air Station Lemoore
 Naval Air Systems Command
 Naval Air Warfare Center - Aircraft Division
 Naval Aviation Depot -- Cherry Point
 Naval Aviation Depot -- Jacksonville
 North Island Naval Aviation Depot
 Tyndall Air Force Base
 T-45 TS Program Office
 Warner-Robins Air Logistics Center

Reductions Achieved

An early benefit of the joint initiative was a cost avoidance of \$6.25M for alternative qualification testing. Working together using the original JG-APP methodology and more recently the joint AP2I process instead of independently prevented each program from incurring \$1.25M in duplicative testing costs.



By coordinating the development of the joint test protocol, alternatives are only qualified and paid for once. This benefit is real. It is in addition to the \$31.3M over 20 years in depot maintenance cost avoidance and other benefits already presented.